

AD 777 545

TECHNICAL REPORT
74-30-FL

EFFECT OF SELECTED BINDERS ON TURKEY ROLL QUALITY

by

Stephen Drake
George Walker
and
Robert Culler

Approved for public release;
distribution unlimited.

February 1974

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760



Food Laboratory

Approved for public release; distribution unlimited.

Citation of trade names in this report does not constitute an official indorsement or approval of the use of such items.

Destroy this report when no longer needed. Do not return it to the originator.

UNCLASSIFIED

Security Classification

AD-777545

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U. S. Army Natick Laboratories Food Laboratory		2a. REPORT SECURITY CLASSIFICATION	
		2b. GROUP	
3. REPORT TITLE Effect of Selected Binders on Turkey Roll Quality			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
5. AUTHOR(S) (First name, middle initial, last name) Stephen R. Drake, George C. Walker, Robert D. Culler			
6. REPORT DATE February 1974		7a. TOTAL NO. OF PAGES 20	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S) 74-30-FL	
b. PROJECT NO. 1G762713A034			
c.		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Natick Laboratories Natick, Mass. 01760	

13. ABSTRACT

Light and dark meat in a ratio of 60 to 40 from young turkeys was cut into 2-inch cubes and made into turkey rolls. Salt, Na tripolyphosphate and gelatin both separately and in combination were used as additives in the processed rolls. It was found that rolls with 1.5% NaCl and 0.3% PO₄ were of significantly higher quality than were rolls containing either NaCl or phosphate, used separately or rolls containing salt and gelatin. Cooked turkey rolls with NaCl and PO₄ in combination had significantly lower oxidative rancidity values (TBA), and significantly lower shear values. Rolls with only 0.1% PO₄ in combination with 1.5% NaCl had as high quality scores as rolls containing 0.3% PO₄ and 1.5% NaCl. Rolls with 0.3% PO₄ and 1.5% NaCl had low oxidative rancidity values similar to rolls with only 0.1% PO₄, or 0.3% PO₄ used separately. Rolls containing a combination of salt and gelatin received the lowest panel scores for color and appearance, and the oxidative rancidity values for those rolls were significantly higher than all other treatments except for 1.5% NaCl.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED

Security Classification

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Matrices (Food)	6					
Food Binders	6					
Additives	6					
Meat	6					
Turkey Rolls	7					
Salts (Inorganic)	6					
Gelatin	6					
Phosphates	6					
Quality	7					
Acceptability	7					
Flavor	7					
Odors	7					
Texture	7					
Color	7					
Moisture Content	7					
Rancidity	7					
Oxidative	0					
Orilitary Requirements	4					

ia

Security Classification

This document has been approved for
public release and sale; its distribution
is unlimited.

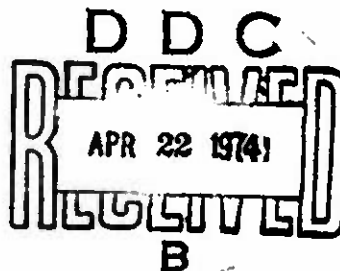
AD _____

TECHNICAL REPORT

74-30-FL

EFFECT OF SELECTED BINDERS ON TURKEY ROLL QUALITY

By: Stephen Drake
George Welker
Robert Culler



Project reference:
1G762713A034

Series
FL -185

February 1974

Food Laboratory
US Army Natick Laboratories
Natick, Massachusetts 01760

id

FOREWORD

The cooked turkey rolls presently used in the military system need improvement. Knowledge is needed on ingredients, used as binders, to improve the quality of turkey rolls. The binders in turkey rolls required by Military Specification (MIL-T-16660D) were compared to binders being used in commercial operations. This study was initiated to determine if a binder could be found which would improve the quality of cooked turkey rolls. This study was undertaken under Project No. 1G762713A034, Military Food Service and Subsistence Technology.

ABSTRACT

Light and dark meat in a ratio of 60 to 40 from young turkeys was cut into 2-inch cubes and made into turkey rolls. Salt, Na tripolyphosphate and gelatin both separately and in combination were used as additives in the processed rolls. It was found that rolls with 1.5% NaCl and 0.3% P04 were of significantly higher quality than were rolls containing either NaCl or phosphate, used separately or rolls containing salt and gelatin. Cooked turkey rolls with NaCl and P04 in combination had significantly lower oxidative rancidity values (TBA), and significantly lower shear values. Rolls with 0.1% P04 in combination with 1.5% NaCl had as high quality scores as rolls containing 0.3% P04 and 1.5% NaCl. Rolls with 0.3% P04 and 1.5% NaCl had low oxidative rancidity values. Whereas rolls with 0.1% P04 and 1.5% NaCl had oxidative rancidity values similar to rolls with only 0.1% P04, or 0.3% P04 used separately. Rolls containing a combination of salt and gelatin received the lowest panel scores for color and appearance, and the oxidative rancidity values for these rolls were significantly higher than all other treatments except for 1.5% NaCl.

TABLE OF CONTENTS

Page

Abstract

Introduction

Experimental Methods

Results and Discussion

Summary and Conclusions

References

LIST OF TABLES

- Table 1. Allo-Kramer shear values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin
- Table 2. Moisture values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin
- Table 3. Color values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin as scored by a sensory panel
- Table 4. Odor values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin as scored by a sensory panel
- Table 5. Flavor values for cooked turkey rolls containing selected combinations of salt, phosphate and gelatin as scored by a sensory panel
- Table 6. Appearance values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin as scored by a sensory panel
- Table 7. Texture values for cooked turkey rolls containing selected combinations of salt, phosphate, and gelatin as scored by a sensory panel
- Table 8. Oxidative rancidity values for cooked turkey rolls containing selected combinations of salt, phosphate and gelatin

INTRODUCTION

Cooked turkey rolls have long been a product of much discussion concerning their undesirable characteristics, and work has been done in recent years to try to improve the product described in Military Specification (MIL-T-16660D). Recent developments by commercial producers (4 and 5) have indicated that superior meat rolls may be obtained through the use of selected additives. The use of phosphates in combination with salt to improved color and taste and to retard oxidative rancidity development in various meat products has also been reported (1).

Military Specification (MIL-T-16660D) requires salt or salt with gelatin as binders in cooked turkey rolls. This study was designed to determine which binders, presently in commercial use, produce the best cooked turkey rolls.

Experimental Methods

Meat from young tom turkeys (light: dark: 60:40) was diced into 2-inch cubes. Salt Na tripoly-phosphate, and gelatin in six treatment combinations (1.5% NaCl, 1.5% NaCl with 2.0% gelatin, 0.3% PO₄, 0.3% PO₄ with 1.5% NaCl, 0.1% PO₄, and 0.1% PO₄ with 1.5% NaCl all wt/wt) were additives in the processed rolls. Turkey and additives were mixed in a Hobart Mixer (Model N-50) for three minutes to insure thorough blending. After blending the product, four pounds, was stuffed into cellulose meat casings, three inches in diameter, and processed in hot water at 87°C until an internal temperature of 76°C was reached. The turkey rolls were placed in a refrigerator operating at 4.5°C, and held until analysis. The analysis of each replication required no longer than five days.

Sensory evaluation for color, odor, flavor, texture and appearance was obtained by using a panel of 20 Food Technologist/replication following the procedure outlined by Larmond (2). Moisture was determined by using 10 samples/replication, and placing the samples in a vacuum oven operating at 70°C with 20 inches of vacuum for 24 hours. Oxidative rancidity (TBA) values were determined by the procedure described by Tarladgis, et al (6) and 8 values/replication were determined. Twenty shear values/replication were determined by using the Allo-Kramer Shear Press equipped with a CW-1 meat cell and a 100-lb force ring. One-eighth inch thick slices of turkey were used in sensory evaluations and shear force determination.

The experiment was designed around accepted statistical methods (3), and an analysis of the data was determined by using the US Army Natick Laboratories Univac Model 1106 computer.

Results and Discussion

Average shear values for cooked turkey rolls containing a combination of salt and phosphate were significantly lower than those of all other treatments in the study (Table 1). These shear values (66.62 and 67.31) indicate a higher degree of tenderness for turkey rolls when manufactured with a combination of 1.5% NaCl and 0.1% or 0.3% P04 used as binders (see Table 7). Turkey rolls with 1.5% NaCl, 0.3% P04, or 1.5% NaCl with 2.0% gelatin had shear values that were similar but significantly superior to rolls containing 0.1% P04. Turkey rolls containing only 0.1% P04 had the highest average shear values (85.06). The only product deemed to be acceptable were those treated with a combination of salt and phosphate.

The amount of moisture in some meat products has a direct influence on the tenderness of the product. Table 2, shows the moisture values for turkey rolls containing combinations of salt, phosphate, and gelatin. Turkey rolls with a combination of salt and phosphate contained significantly more moisture (64.05 and 63.75) than did all other treatments. There was no significant difference between the moisture values for turkey rolls with 1.5% NaCl (61.75) and those with 0.3% P04 (61.67). However, the 1.5% NaCl or 0.3% P04 turkey rolls contained significantly more moisture than those containing 0.1% P04 (59.92) or 1.5% NaCl with 2.0% gelatin (60.05). In fact, rolls with only 0.1% P04 held less moisture than did all other treatments. The high moisture content for turkey rolls with a combination of salt and phosphate can be related to the low shear values found for these treatments in Table 1. By the same token treatments with low moisture values demonstrated high (poor) shear values.

On a hedonic scale of 9 equals excellent and 1 equals extremely poor, product with sensory scores less than 6 (below good above fair) were deemed unacceptable in this experiment (2). Color values for cooked turkey rolls with combinations of salt, phosphate, and gelatin are shown in Table 3. Turkey rolls containing 1.5% NaCl, 1.5% NaCl with 0.1% P04, or 1.5% NaCl with 0.3% P04 were the only treatments to receive acceptable color scores. Rolls with a combination salt and phosphate received the best panel scores (6.35 and 6.27), for color, but these scores were not significantly higher than the score received by rolls containing only 1.5% NaCl (6.00). Turkey rolls with 0.1% P04, 0.3% P04, or 1.5% NaCl with 2.0% gelatin received panel scores (5.70, 5.83, and 5.03) that were unacceptable, but the scores 5.70 and 5.83 for rolls containing 0.1% P04 or 0.3% P04 were not significantly different from the score (6.00) determined for rolls containing only 1.5% NaCl. Turkey rolls with either 0.1% or 0.3% P04 used in combination with 1.5% NaCl were of superior color when compared to the other treatments in this study.

Sensory evaluation scores for odor are found in Table 4. Cooked turkey rolls containing 1.5% NaCl (6.03), 0.3% P04 with 1.5% NaCl (6.38), 0.1% P04 (6.03) and 0.1% P04 with 1.5% NaCl (5.18) received panel scores not significantly different from each other, and only the treatment (0.3% P04 and 1.5% NaCl) can be considered to improve the odor of turkey rolls made under the condition of this study.

Table 1

Allo-Kramer shear values for cooked turkey rolls containing
selected combinations of salt, phosphate, and galatin

Replications	Observations/ treatment	Treatments					
		1.5% NaCl	1.5% NaCl 2.0% Galatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
A.	20	68.75	77.95	76.30	76.45	88.65	74.05
B.	20	84.05	84.15	78.35	66.25	86.50	64.45
C.	20	74.45	77.65	69.60	64.70	79.40	64.90
D.	20	64.35	60.90	67.90	61.85	85.70	62.10
Mean ± S.D.		72.90 ^b	75.16 ^b	73.03 ^b	67.31 ^c	85.06 ^a	66.62 ^c
		±	±	±	±	±	±
		13.84	14.35	13.96	12.36	13.23	10.73

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Table 2.

**Moisture values for cooked turkey rolls containing
selected combination of salt, phosphate, and gelatin**

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.05% Gelatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
A.	10	62.00	61.00	64.90	64.70	61.00	66.10
B.	10	61.60	59.60	60.90	63.30	59.00	61.90
C.	10	62.60	60.00	61.20	65.30	60.90	64.70
D.	10	60.80	59.00	59.70	62.90	58.20	62.30
Mean							
±S.D.		61.75 ^b	60.05 ^c	61.67 ^b	64.05 ^a	59.92 ^c	63.75 ^a
		±	±	±	±	±	±
		1.03	1.23	2.01	1.23	1.73	1.82

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 40.

Table 3.

Color values for cooked turkey rolls containing selected combinations of salt, phosphata, and gelatin as scored by a sensory panel

Repli- cations	Observa- tions/ traatmt	Treatments					
		1.5 NaCl	1.5% NaCl 2.0 Gelatin	0.3% Po4	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
A.	20	6.30	5.75	6.25	6.55	5.40	6.50
B.	20	5.35	5.00	5.65	6.00	5.20	6.30
C.	20	6.00	4.25	5.50	6.35	5.90	6.10
D.	20	6.35	5.15	5.95	6.50	6.30	6.20
Mean ± S.D.		6.00 ^{ab}	5.03 ^c	5.83 ^{ab}	6.35 ^a	5.70 ^b	6.27 ^a
		±	±	±	±	±	±
		1.10	1.36	1.11	0.99	1.26	1.00

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Table 4.

Odor values for cooked turkey rolls containing selected combinations of salt, phosphate and gelatin as scored by a sensory panel

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.0 Gelatin	0.3% P04	1.5% NaCl 0.3% P04	01.% P04	1.5% NaCl 0.1% P04
A.	20	6.55	6.30	6.40	6.55	6.15	6.35
B.	20	5.65	5.95	6.00	6.45	6.05	5.75
C.	20	5.80	4.95	5.85	6.20	5.70	6.30
D.	20	6.15	5.45	5.70	6.35	6.25	6.35
Mean ± S.D.		6.03 ^{ab}	5.66 ^b	5.98 ^{ab}	6.38 ^a	6.03 ^{ab}	6.18 ^{ab}
		±	±	±	±	±	±
		1.14	1.31	1.11	0.94	0.96	1.24

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Sensory panel scores, in Table 5, for flavor, ranged from a low of 5.07 to a high of 6.37. Of all the treatments in the study only those that have a combination of salt and phosphate received acceptable scores (in excess of 6.00). Cooked turkey rolls with phosphate at a concentration of either 0.1% or 0.3% in combination with 1.5% NaCl received scores (6.32 and 6.37) that were not significantly different. Rolls with only 0.1% or 0.3% P04 received the lowest scores of all the treatments, but these scores (5.07 and 5.26) were not significantly different from the scores (5.71 and 5.43) obtained for rolls that contained 1.5% NaCl and 1.5% NaCl with 2.00% gelatin. Under the conditions of this study, flavor acceptance dictates that cooked turkey rolls contain a combination of phosphate and salt as binding agents.

Appearance has a large influence on the acceptability of a product. Sensory panel scores for appearance are shown in Table 6. The appearance of cooked turkey rolls that had a combination treatment of salt and phosphate were judged superior to the other treatments, but only those rolls with 1.5% NaCl and 0.3% P04 received a score (6.28) significantly different from all other treatments. Rolls with 1.5% NaCl and 0.1% P04 were judged to be equal to those rolls containing only 1.5% NaCl (6.22 compared to 5.80). There was no significant difference between rolls with 1.5% NaCl (5.80), 0.3% P04 (5.32) or 0.1% P04 (5.38). Turkey rolls containing 1.5% NaCl with 2% gelatin and those with only 0.1% P04 received the lowest scores (5.13 and 5.38) of all the treatment. The extremely poor score for rolls containing salt and gelatin can be directly related to the poor score for color found for this treatment in Table 3. In judging color and appearance panel members reported that rolls containing salt and gelatin had an objectionable greenish color.

Sensory panel scores for texture (Table 7) range from a low of 5.48 (1.5% NaCl + 2.0% gelatin) to a high of 6.37 (1.5% NaCl + 0.3% P04). Cooked turkey rolls treated with a combination of salt and phosphate, at either 0.1% or 0.3% concentration, received significantly higher scores than did the other treatments. The values for salt and phosphate treated turkey rolls exceeded 6 in both instances (6.30 and 6.37). The other four treatments received scores that were similar to each other, but all were judged to be unacceptable in texture.

The high texture scores for turkey rolls treated with a combination of salt and phosphate (Table 7), are directly related to the low shear values for these rolls (Table 1). The shear values demonstrated that rolls treated with either 0.1% P04 or 0.3% P04 and 1.5% NaCl sheared easily and with significantly less force than was required for the remaining treatments.

A combination of 1.5% NaCl with 0.3% react to retard oxidative rancidity had lower (TBA) values than did all other treatments as shown in Table 8. Rolls that contained only 0.3% P04 had lower oxidative rancidity values than did rolls containing 0.1% P04, or 1.5% NaCl with 0.1% P04, but the values (8.32, 9.74, or 9.35) were not significantly

Table 5.

Flavor values for cooked turkey rolls containing selected a combination of salt, phosphate, and gelatin as scored by a sensory panel

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.0% Gelatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
A.	20	5.95	5.00	5.10	6.50	5.55	6.45
B.	20	5.55	4.50	4.85	6.25	4.80	6.45
C.	20	5.10	5.95	4.70	6.20	4.75	6.20
D.	20	6.25	6.30	6.40	6.55	5.20	6.20
Mean ± S.D.		5.71 ^b	5.43 ^b	5.26 ^b	6.37 ^a	5.07 ^b	6.32 ^a
		±	±	±	±	±	±
		1.17	1.33	1.29	1.08	1.24	1.06

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Table 6.

Appearance values for cooked turkey rolls containing selected combinations of salt, phosphata, and gelatin as scored by a sensory panel

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.0% Gelatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1%P04
A.	20	5.80	5.75	6.30	6.45	5.25	6.20
B.	20	5.20	5.10	5.10	6.25	4.75	6.25
C.	20	5.85	4.40	5.50	6.10	5.60	6.15
D.	20	6.35	5.30	5.60	6.35	5.95	6.30
Mean ± S.D.		5.80 ^{bc}	5.13 ^d	5.62 ^c	6.28 ^a	5.38 ^{cd}	6.22 ^{ab}
		±	±	±	±	±	±
		1.18	1.21	1.12	0.81	1.21	1.02

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Table 7.

Texture values for cooked turkey rolls containing selected combinations of salt, phosphata, and gelatin as scored by a sensory panel

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.0% Gelatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
A.	20	5.80	6.10	6.35	6.50	5.30	6.45
B.	20	4.95	5.40	5.15	6.40	5.15	6.25
C.	20	5.55	4.95	5.70	6.30	6.65	6.15
D.	20	6.15	5.50	5.70	6.30	5.80	6.35
Mean ± S.D.		5.61 ^b	5.48 ^b	5.72 ^b	6.37 ^a	5.49 ^b	6.30 ^a
		±	±	±	±	±	±
		1.08	1.31	1.11	0.98	1.31	0.94

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 80.

Table 8.

Oxidative rancidity values for cooked turkey rolls containing
selected combinations of salt, phosphate and gelatin

Repli- cations	Observa- tions/ treatmt	Treatments					
		1.5% NaCl	1.5% NaCl 2.0% Gelatin	0.3% P04	1.5% NaCl 0.3% P04	0.1% P04	1.5% NaCl 0.1% P04
	4	13.71	12.81	10.39	4.88	12.26	10.12
B.	4	13.18	13.73	8.13	5.95	7.03	6.72
C.	4	14.92	13.53	7.07	1.40	9.23	9.49
D.	4	13.71	15.70	7.70	2.49	10.42	11.06
Mean ± S.D.		14.04 ^a	13.94 ^a	8.32 ^b	3.68 ^c	9.74 ^b	9.35 ^b
		±	±	±	±	±	±
		0.74	1.23	1.44	2.73	2.19	1.87

1. Any mean not followed by a common letter differs significantly at the 1% level of probability as determined by Duncan's New Multiple Range Test.
2. Total observations/treatment = 16.

different from each other. The standard military turkey rolls, containing 1.5% NaCl, or 1.5% NaCl with 2.0% gelatin, developed significantly higher oxidative rancidity values than did all other treatments. Turkey rolls treated with 1.5% NaCl without the addition of phosphate produced the highest rancidity values (14.04). In all other factors evaluated, turkey rolls with either 0.1% P₀₄ or 0.3% P₀₄ in combination with 1.5% NaCl were similar to each other, 0.1% P₀₄ was not enough to retard rancidity development significantly. 0.3% P₀₄ and 1.5% NaCl must be used in this combination to retard oxidative rancidity development.

Summary and Conclusions

It is evident that cooked turkey rolls containing a combination of salt and phosphate are superior to those of the other treatments under the conditions of this study. Turkey rolls with either 0.1% or 0.3% P₀₄ and 1.5% NaCl are similar except when oxidative rancidity is a factor. Only those turkey rolls containing 0.3% P₀₄ and 1.5% NaCl significantly retard oxidative rancidity development. Cooked turkey rolls containing salt, phosphate or salt with gelatin were inferior to those rolls containing a combination of salt and phosphate at either 0.1% or 0.3% concentration. Turkey rolls with either 0.1% or 0.3% P₀₄ concentration without the aid of salt were deemed poorest in quality.

Military Specification (MIL-T-16660D) required that salt alone or salt with gelatin be used as binders in cooked turkey rolls. A combination of salt and phosphate was found to be a superior binder and it is recommended that a binder consisting of 1.5% NaCl with 0.3% P₀₄ replace those binders currently used in Military Specification (MIL-T-16660D).

REFERENCES

1. Demon, J. M. and P. Mehnychn. 1971. Phosphates in Food Processing. Avi. Publishing Co. Westport, Conn.
2. Larmond E. 1970. Methods for Sensory Evaluation of Food. Canada Dept. of Agr. Pub. 1284.
3. Little, T. M. and F. J. Hills. 1972. Statistical Methods in Agriculture research. Agr. Ext. Service, Univ. of Calif.
4. Maas, R. H. 1971. US Patent 3,076,713.
5. Schwall, D. V., G. Ellyn and R. B. Roger. 1971. US Patent 3,413,07.
6. Tarladgis, B. G., B. M. Watts and M. T. Younathan. 1960. A distillation Method for the Quantitative Determination of Malonaldehyde in Rancid Foods. JAOCS Vol. 37, pp 44-43.